PMLevyCOLPEm Resource

From: Hambrick, Gordon A SAJ [Gordon.A.Hambrick@usace.army.mil]
Sent: Friday, July 29, 2011 2:24 PM
To: Bruner, Douglas
Subject: RE: PEF PowerPoint Presentation - Part 2 (UNCLASSIFIED)
Attachments: Part 2 - Slides for PEF USACE Presentation 07282011 v2.pptx

Classification: UNCLASSIFIED
Caveats: NONE

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Caveats: NONE

Hearing Identifier: Levy_County_COL_Public
Email Number: 847

Mail Envelope Properties (C080DBADDF98F6408613AA42235E676401CE445E)

Subject: RE: PEF PowerPoint Presentation - Part 2 (UNCLASSIFIED)
Sent Date: 7/29/2011 2:24:12 PM
Received Date: 7/29/2011 2:25:52 PM
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Tracking Status: None

Post Office: SAJ-ML4JAX.saj.ds.usace.army.mil

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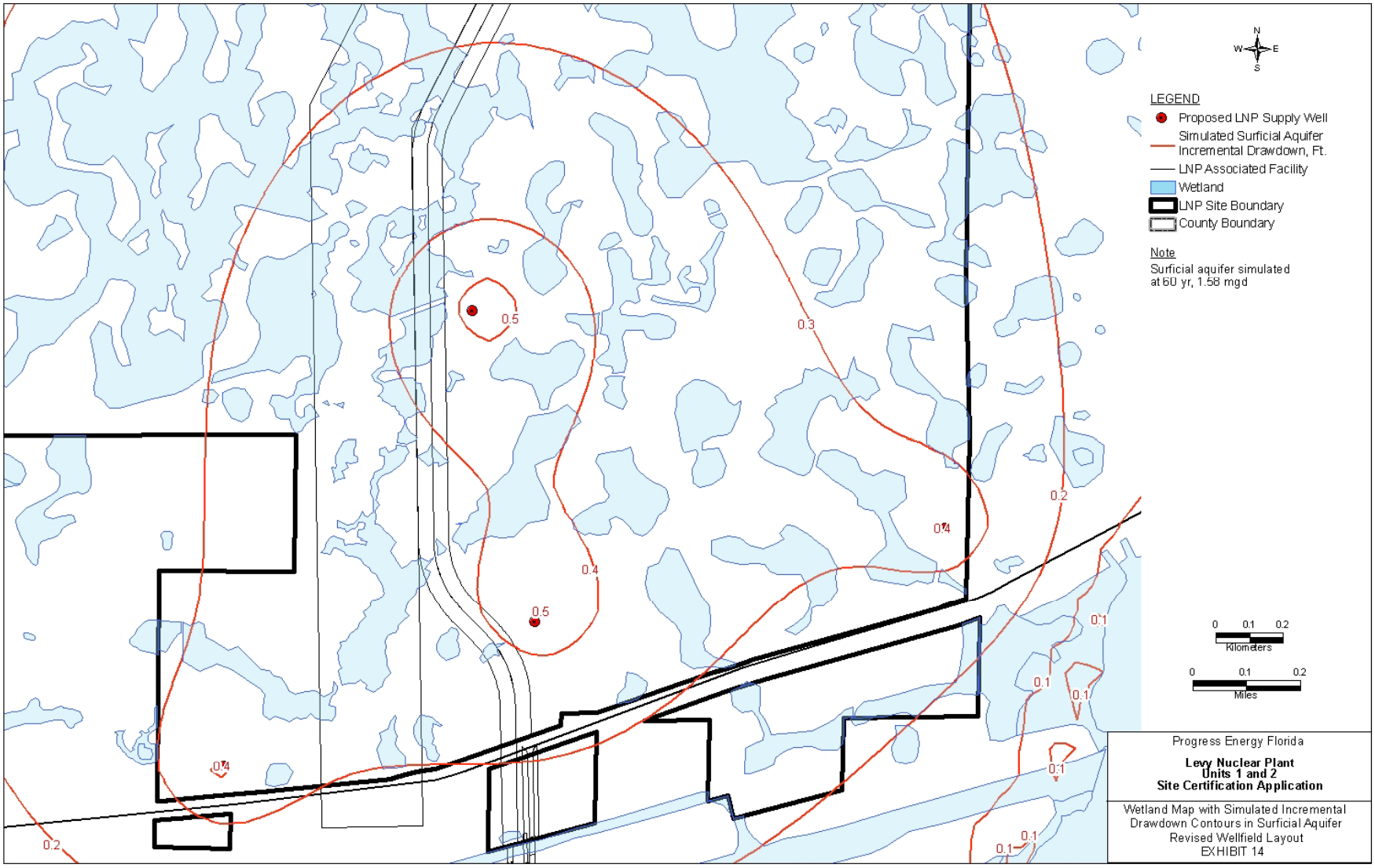
SAS Drawdown <0.4 ft Beneath Limited Area of Wetlands after 60 yrs



Specific Topics for Discussion

USACE Comments on Differences Between 3 Layers vs. 5 Layers in the Models

- The model is constructed with 5 layers, each representing a regional aquifer system within the DWRM2 model domain
- Vertical flow between each layer is represented by leakance, recharge is applied to the uppermost layer and is calculated as net recharge, and the evapotranspiration (ET) function is not used
- The model layers include:
  - Layer 1 – Surficial aquifer system (SAS)
  - Layer 2 – Intermediate aquifer or confining bed not present in the area, designated active in the TMR model
  - Layer 3 – Intermediate aquifer or confining bed not present in the area, designated active in the TMR model
  - Layer 4 – Upper Floridan aquifer (UFA)
  - Layer 5 – Lower Floridan aquifer (LFA)

NGG Think Fleet.

Progress Energy

Surficial Aquifer is Highly Influenced by Model Assumptions

- The vertical boundary conditions vary in the SAS (Layer 1) using active, drain, and river cells to define the movement of water in and out of the SAS
- The SAS varies from 30 to 70 feet thick in the DWRM2 model which is consistent with the data from the site
- Most of the Layer 1 cells in the DWRM2 model are drain cells allowing water to exit the model at a set elevation - drain cells are used to represent the high water table and groundwater discharge to land surface in the coastal wetlands and springs
- River cells function in the same manner as drain cells but also allow water to enter the model if the simulated water level in the aquifer falls below the head of the river
- River cells are used to represent Lake Rousseau and the Withlacoochee River

Intermediate Aquifer Layers are Transparent in the DWRM2 5 layer Model

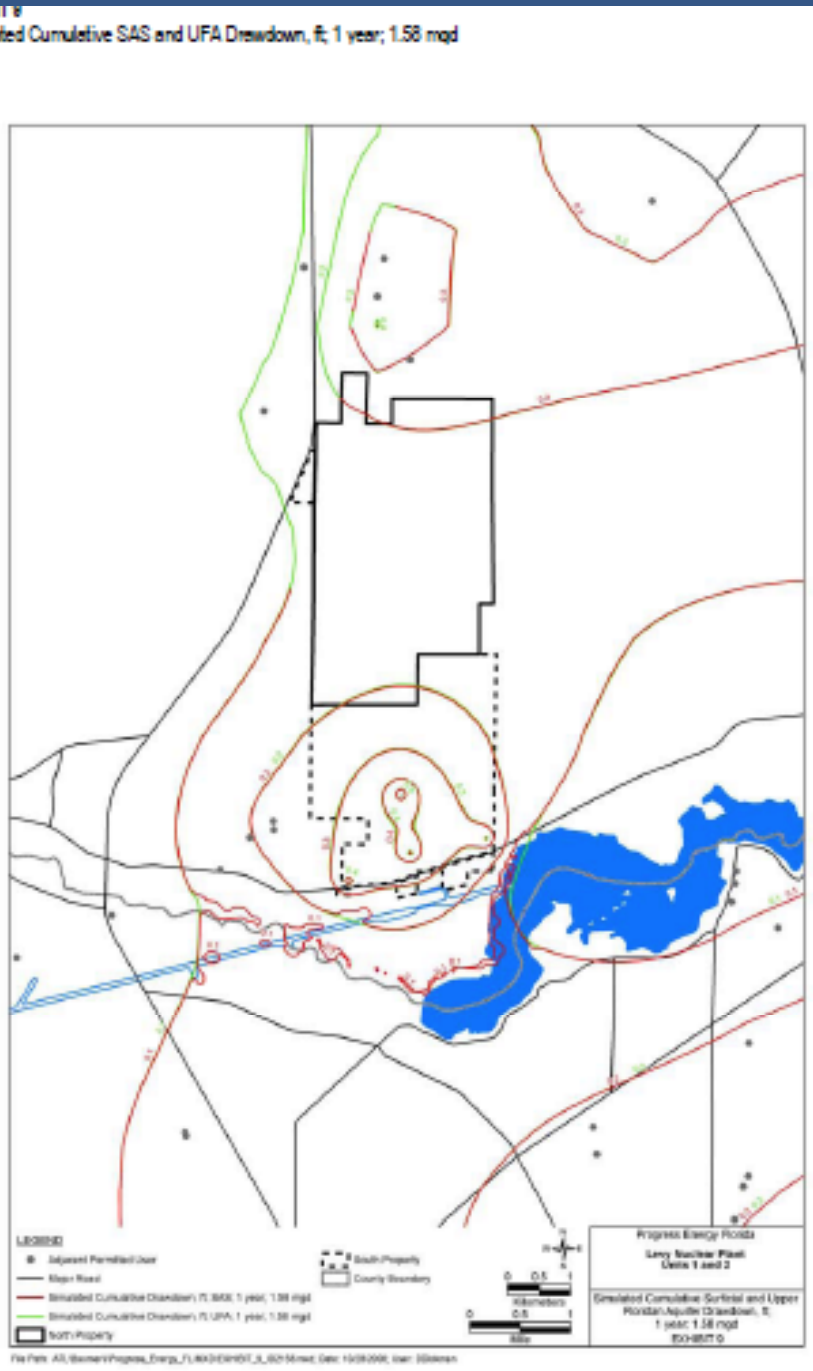
- Layers 2 and 3 represent intermediate aquifers or confining beds in the DWRM2 model
- Formations are present in other areas of the SWFWMD between the SAS and the UFA that are not present at the site
- The intermediate aquifer or confining beds are active but have no impact on the vertical flow between the SAS and the UFA
- This is demonstrated by the fact that the 1 and 60 yr water level contours in the SAS and UFA are identical
- Therefore, the 5 layer model functions the same as a 3 layer model

NGG Think Fleet.

Progress Energy

SAS and UFA Regional Drawdown after 1 yr

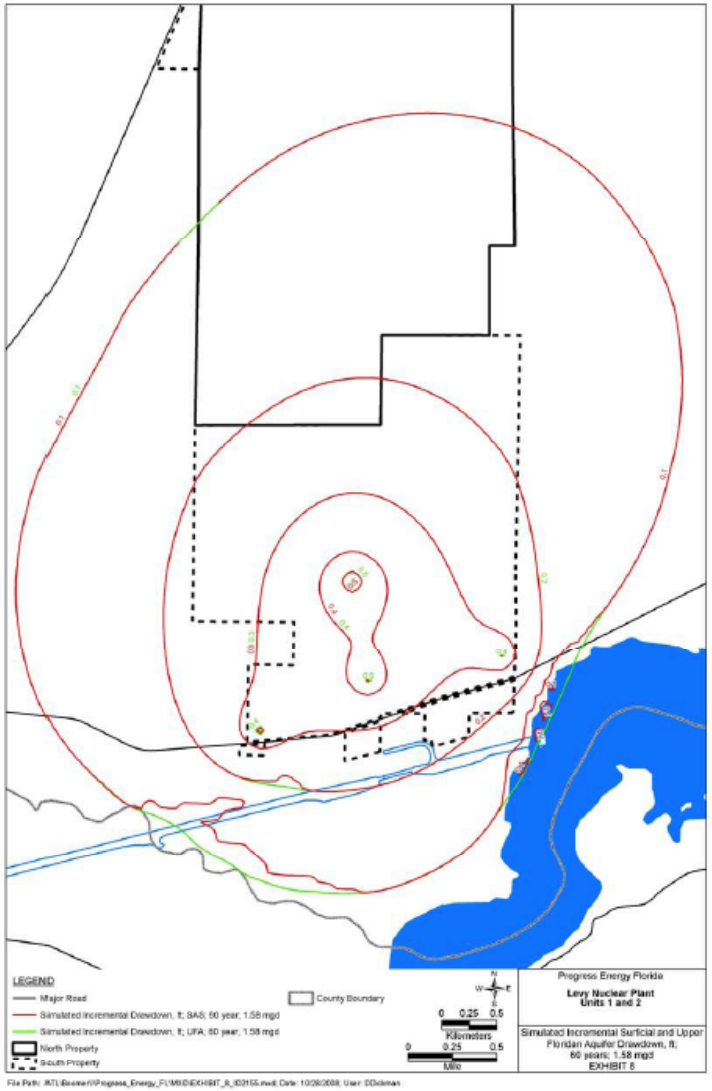
The SAS and UFA water levels are identical after one year of pumping demonstrating that the intermediate model layers do not influence vertical flow



SAS and UFA Regional Drawdown Virtually Identical after 60 yrs

The SAS and UFA water levels are identical after 60 yrs of pumping demonstrating that the intermediate model layers do not influence vertical flow

EXHIBIT 8
Simulated Incremental SAS and UFA Drawdown, ft; 60 years; 1.58 mgd



NGG Think Fleet.

Floridan Aquifer Represented by 2 Layers

- Layer 4 is the Upper Floridan aquifer (UFA), which is the production interval for the wellfield
- Layer 5 is the Lower Floridan aquifer (LFA) and represents the deeper intervals of the Floridan
- LFA cells are active only in the northeastern corner of the TMR model to simulate brackish water

USACE Comments on Use of No-Flow Conditions to Represent Brackish Water

- The SWFWMD's DWRM2 model is based on the USGS's regional groundwater flow model known as the "Mega-Model." The Mega Model documentation states that:

- *Because this model is restricted to simulating the movement of freshwater within aquifers, areas where the intermediate aquifer system (IAS), the upper Floridan aquifer (UFA), and the lower Floridan aquifer (LFA)… contain water with chloride concentrations exceeding 5,000 mg/L are considered inactive, thus minimizing potential errors introduced by simulating aquifer areas containing water of variable density....*

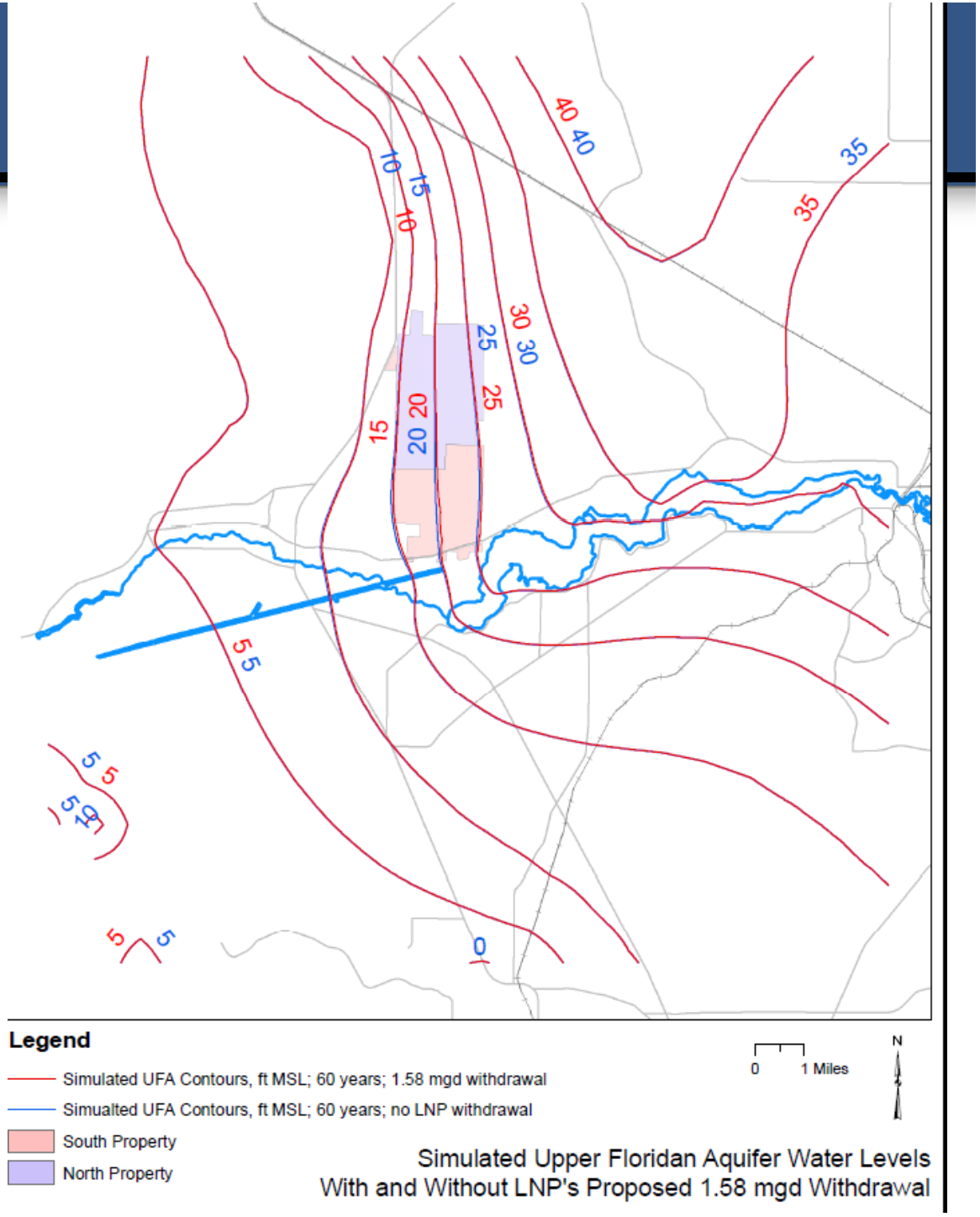
- *… The saltwater part of the Floridan aquifer System (FAS) was not included in the model because the interface is relatively sharp and movement of the interface is assumed to have little or no effect on simulated heads…. The assumption was made that a sharp freshwater-saltwater interface occurs laterally and that flow across this interface is negligible. This sharp interface determined which model areas were considered active*.

- Consequently, only the portion of the LFA that is active in the TMR model is considered to be fresh water - for this reason, portions of Layer 5 are designated no-flow in the study area to represent brackish groundwater

Comments on Running the Model Under Steady State vs. Transient Conditions

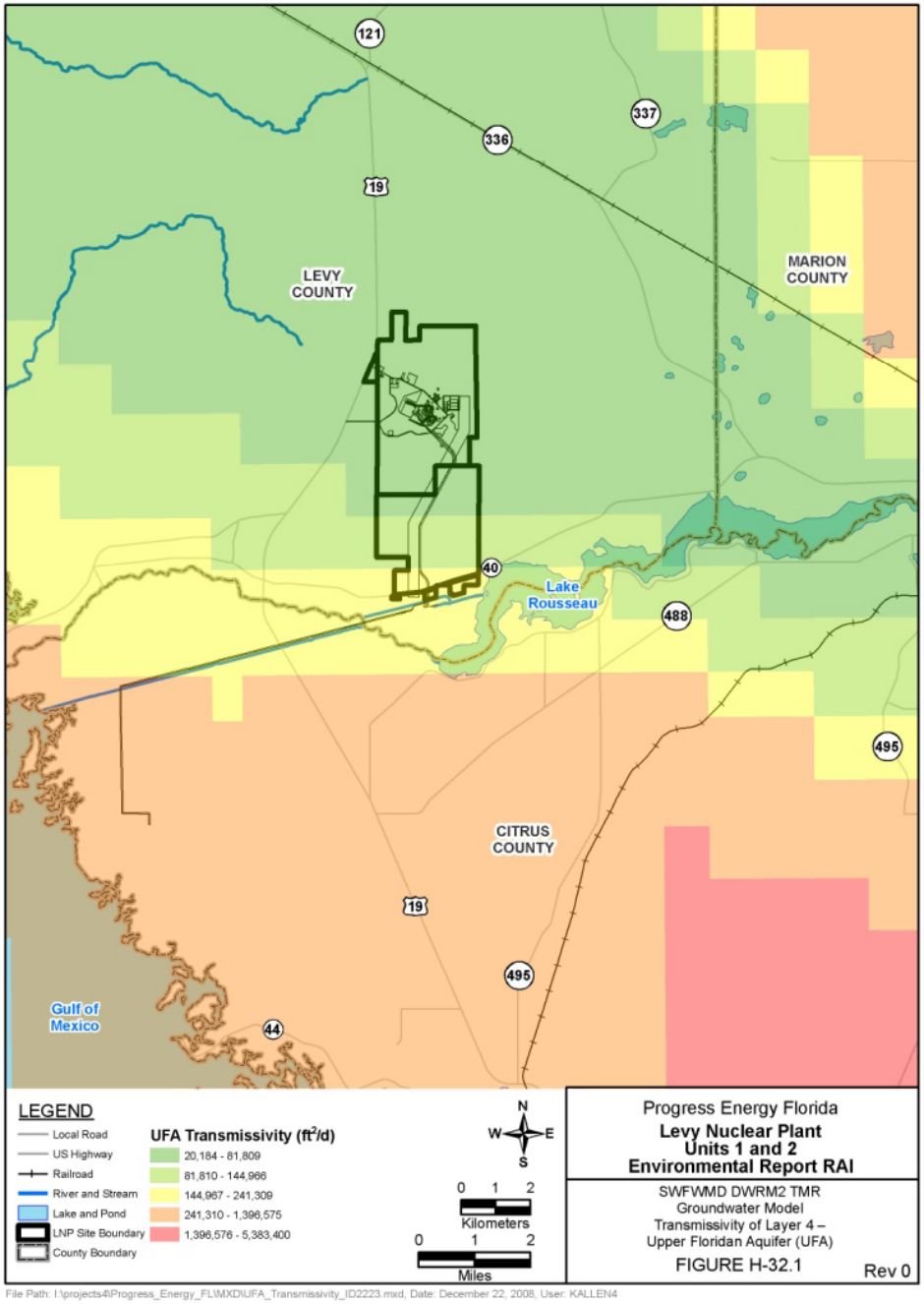
- Model simulations were prepared as requested by the SWFWMD
- The model simulations were run for the proposed 60-year operating life of the facility - the model includes three stress periods.
  - Stress Period 1 is a steady-state stress period that represents pre-development conditions; there are no well withdrawals simulated from the model
  - Stress Period 2, also steady-state, includes all other users except LNP - it is intended to provide an assessment of currently permitted impacts
  - Stress Period 3 is the transient predictive phase of the simulation - for this simulation, the stress period length was increased to 60 years to represent the expected life of the facility

UFA Water Levels with & w/o LNP in DWRM2 Model

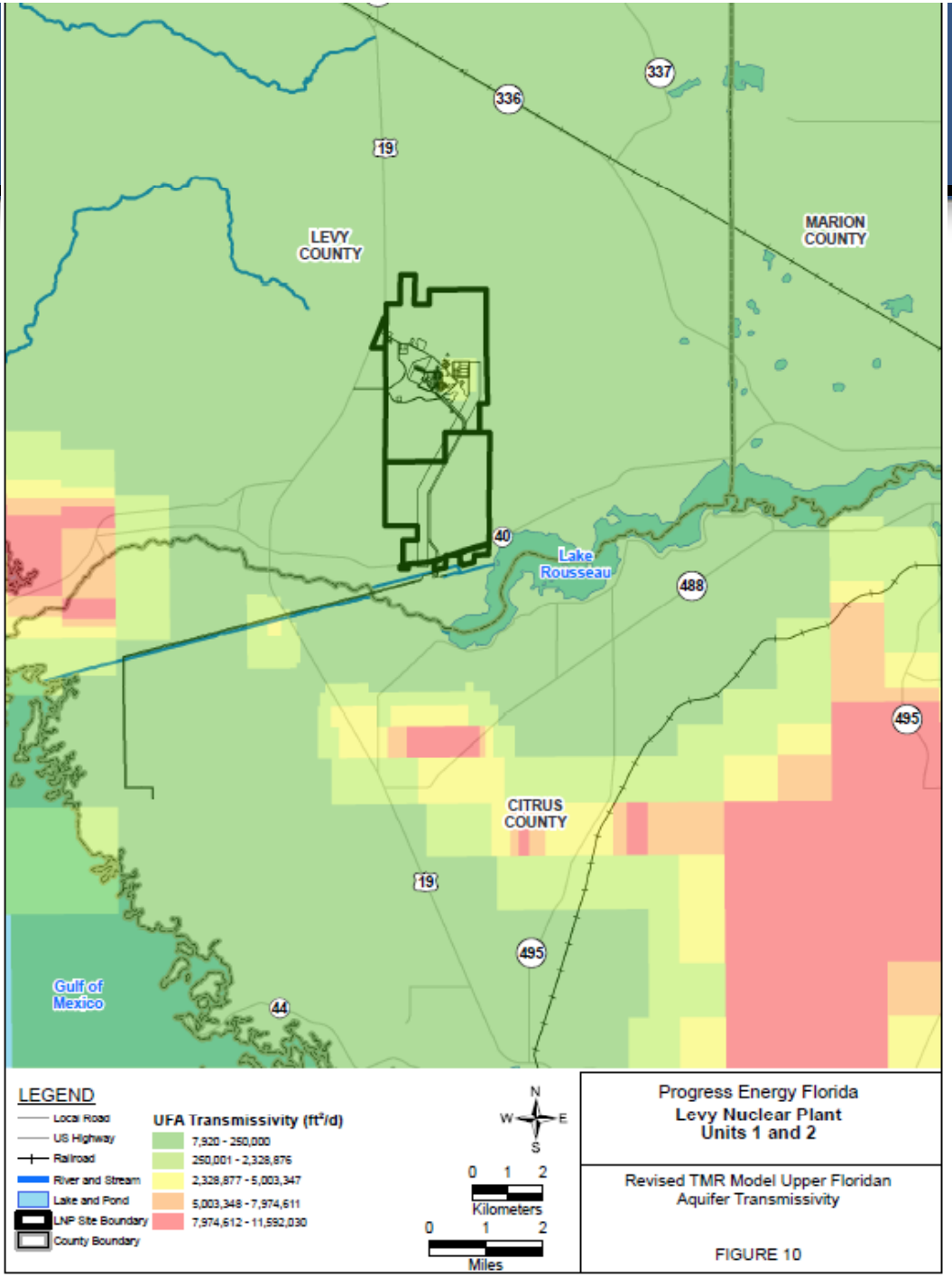


Simulated Upper Floridan Aquifer Water Levels
With and Without LNP's Proposed 1.58 mgd Withdrawal

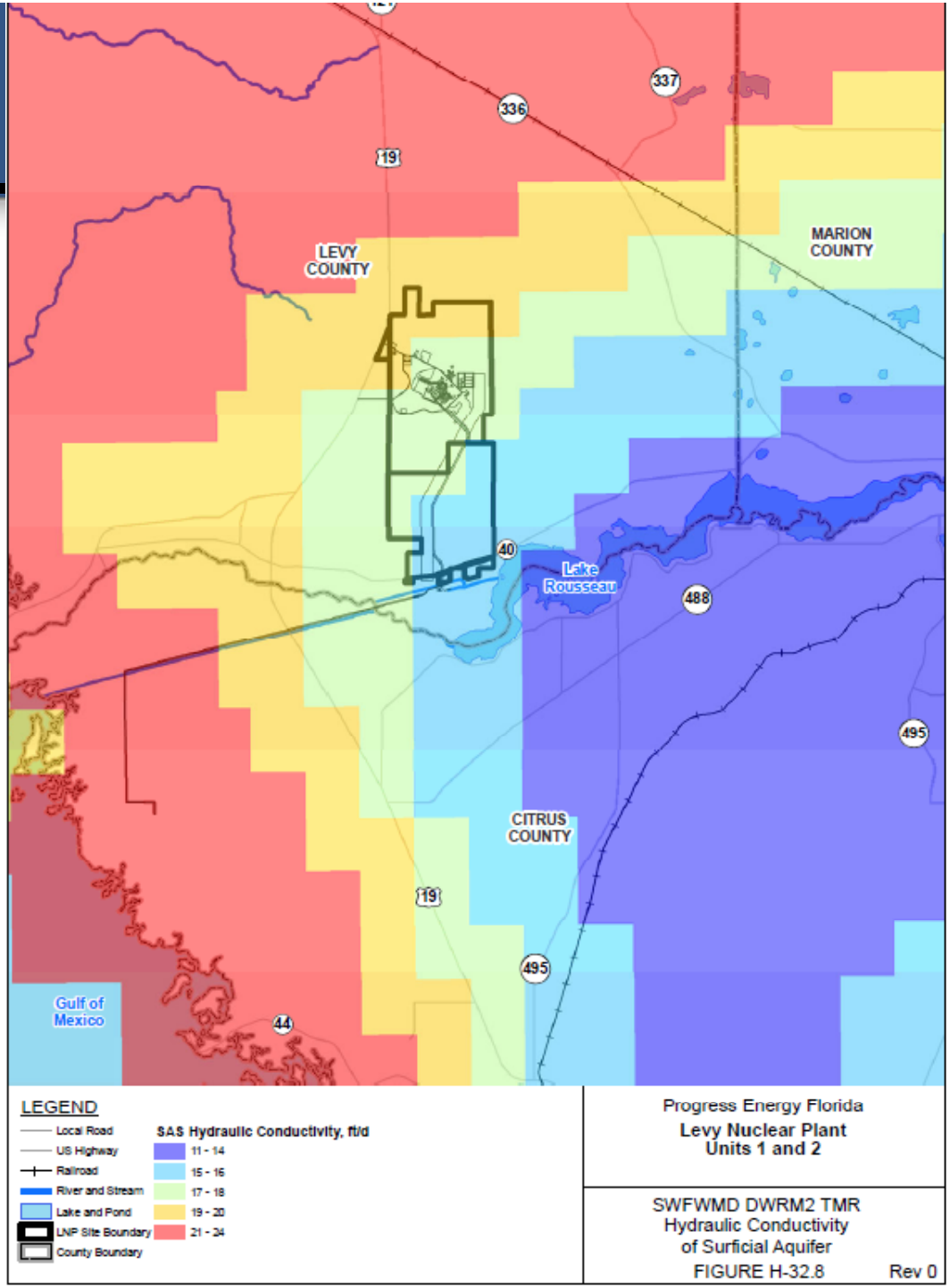
UFA Transmissivity in DWRM2 Model



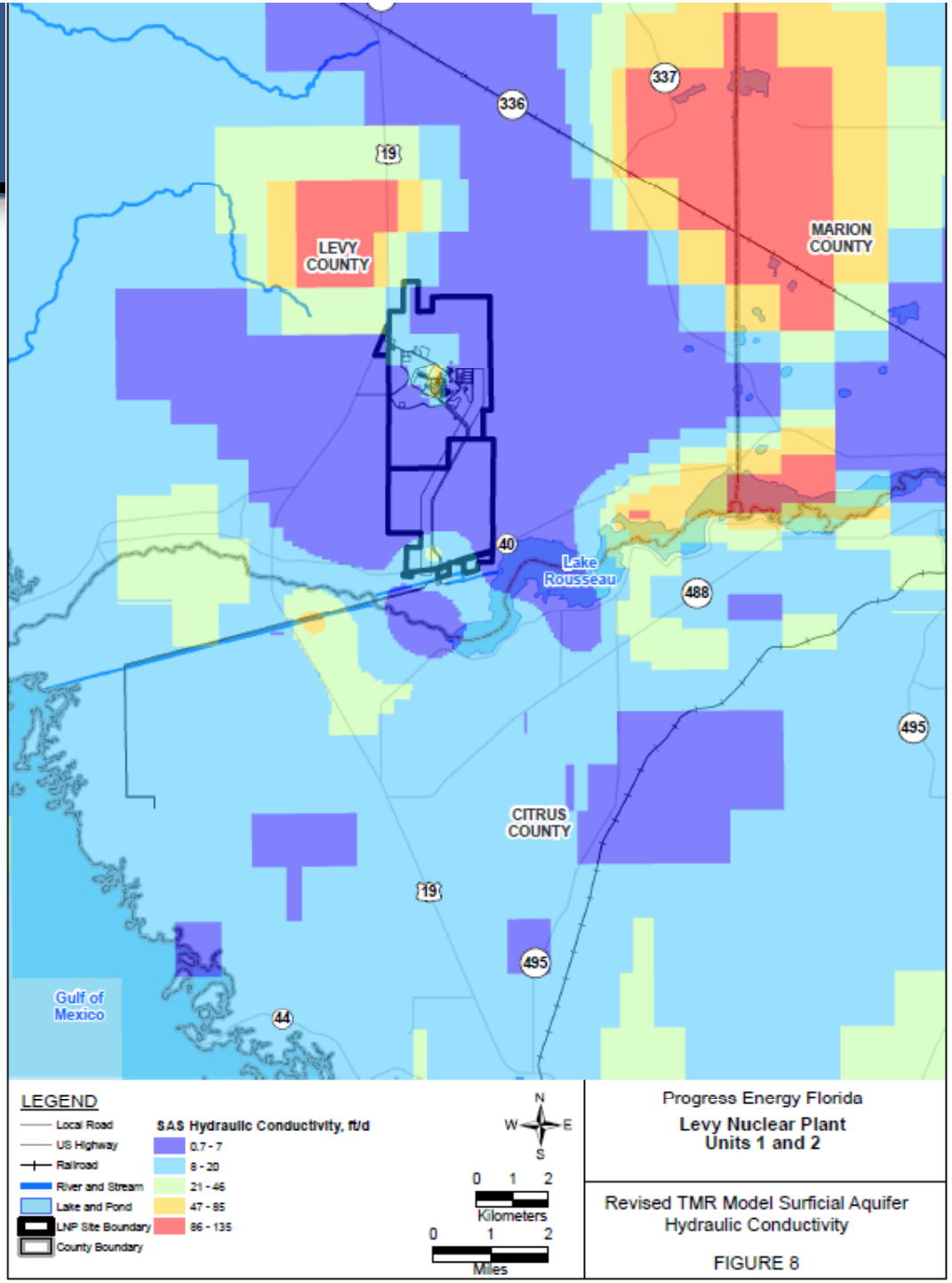
UFA Transmissivity in Recalibrated Model



Hydraulic Conductivity of SAS in DWRM2 Model



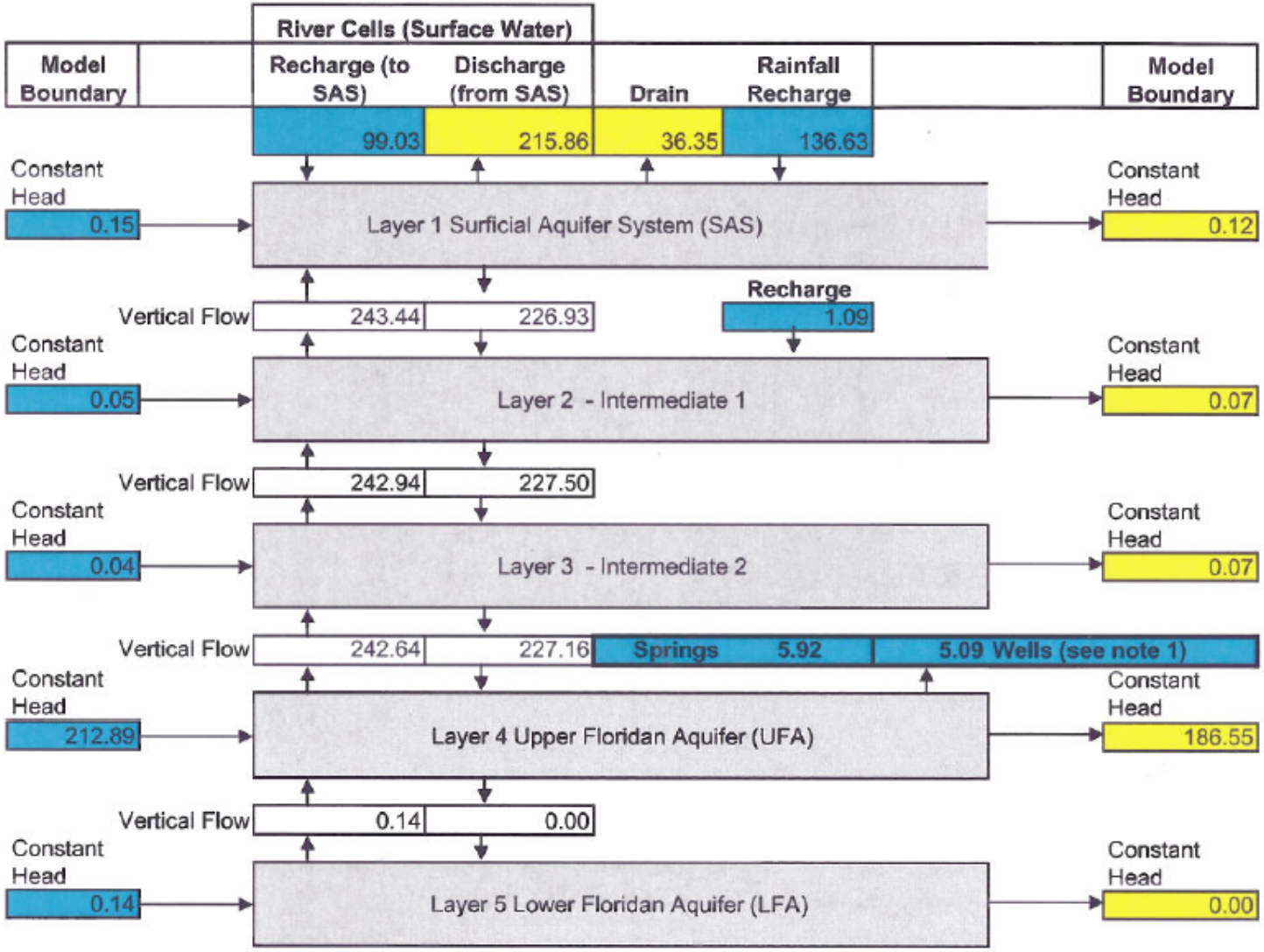
Hydraulic Conductivity of SAS in Recalibrated Model



Comparison of 3- and 5-Layer Models

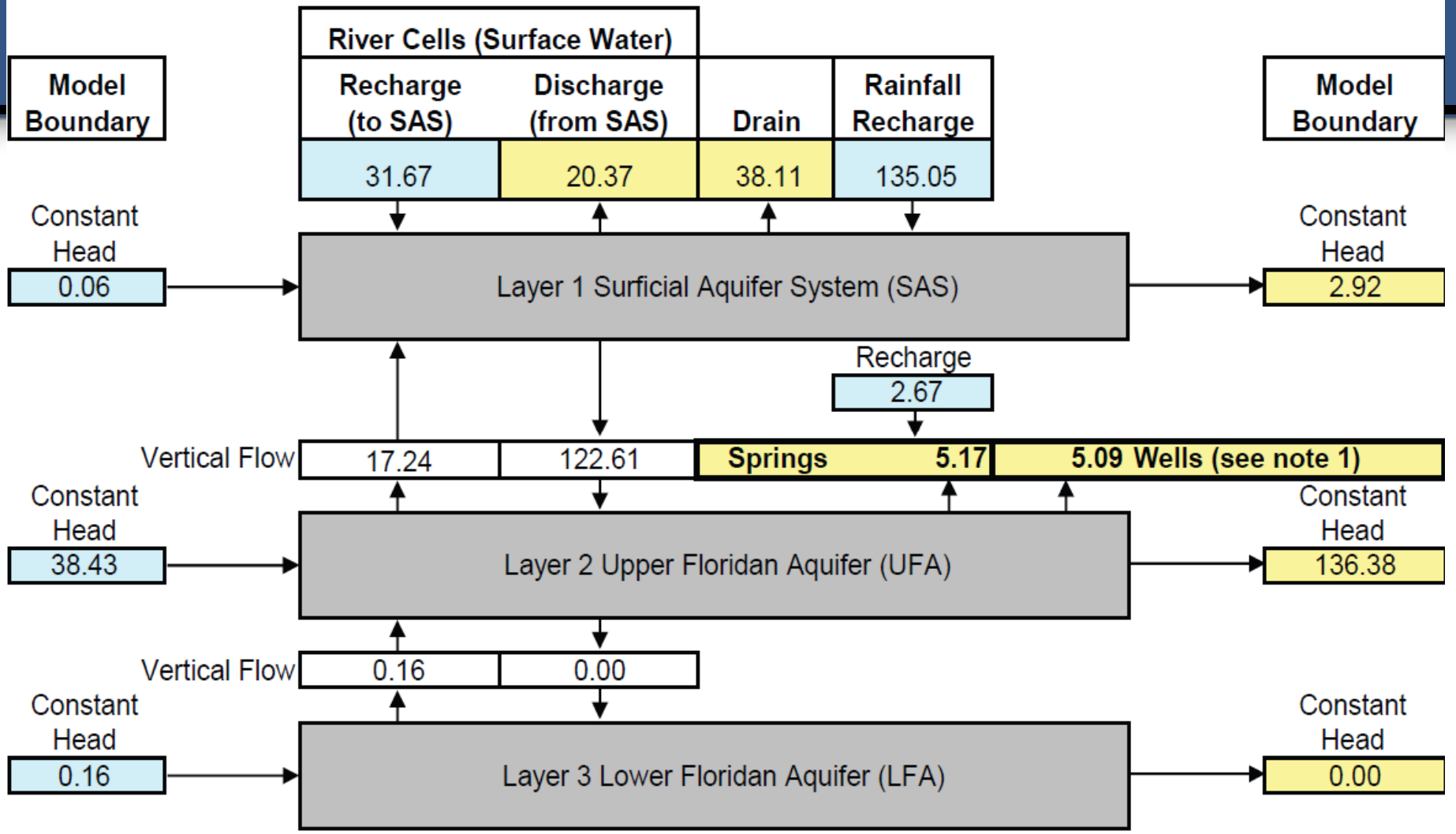
- The 5-Layer Model Better Represents the Conceptual Model of Groundwater Flow
  - Overall Water Budget
  - Vertical and Lateral Flow
  - Aquifer / River Interaction
- The 5-Layer Model does not Under-Estimate SAS Drawdown due to the Additional Layers

TMR Model Water Budget with LNP Withdrawing 1.58 mgd (all values MGD)



Note 1: Well withdrawal comprised of 3.51 mgd from other users (model calibration year 2001) + 1.58 mgd for LNP

Inflow	Outflow	Difference	% Difference
450.03	450.03	0.00	0.00%



Note 1: Well withdrawal comprised of 3.51 mgd from other users (model calibration year 2001) + 1.58 mgd for LNP

Inflow	Outflow	Difference	% Difference
208.04	208.04	0.00	0.00%

Water Budget Comparison

Water Budget Component		3-layer	5-layer
SAS / UFA flow			
	SAS recharge to UFA	122	227
	UFA discharge to SAS	17	243
	Net flow from SAS to UFA	105	-16
UFA lateral flow			
	In	38	213
	Out	136	187
Rainfall recharge			
	to SAS	135	137
	to UFA	3	1
River cells			
	Baseflow from SAS	20	216
	Losses to SAS	31	99
Drain discharge			
	from SAS	38	36
	from UFA (springs)	5	6

All units are mgd, steady-state

Vertical Flow Between SAS and UFA

- In the 3-layer model, the SAS is the primary source of recharge for the UFA, which has virtually no lateral flow
- In the 5-layer model, there are nearly equal amounts of upwards and downwards flow

Lateral Flow in the UFA

- 3-Layer Model
  - 38 mgd inflow
  - 137 mgd outflow
  - 99 mgd net outflow
- 5-Layer Model
  - 213 mgd inflow
  - 187 mgd outflow
  - 26 mgd net inflow

Vertical Flow Between SAS, UFA, and River Cells

Lake Rousseau and the Withlacoochee River are hydraulically connected to the UFA and can serve as recharge source or discharge sink depending on relative water levels

Water Budget Component	3-layer	5-layer
SAS / UFA flow		
SAS recharge to UFA	122	227
UFA discharge to SAS	17	243
Net flow from SAS to UFA	105	-16
River cells		
Baseflow from SAS	20	216
Losses to SAS	31	99

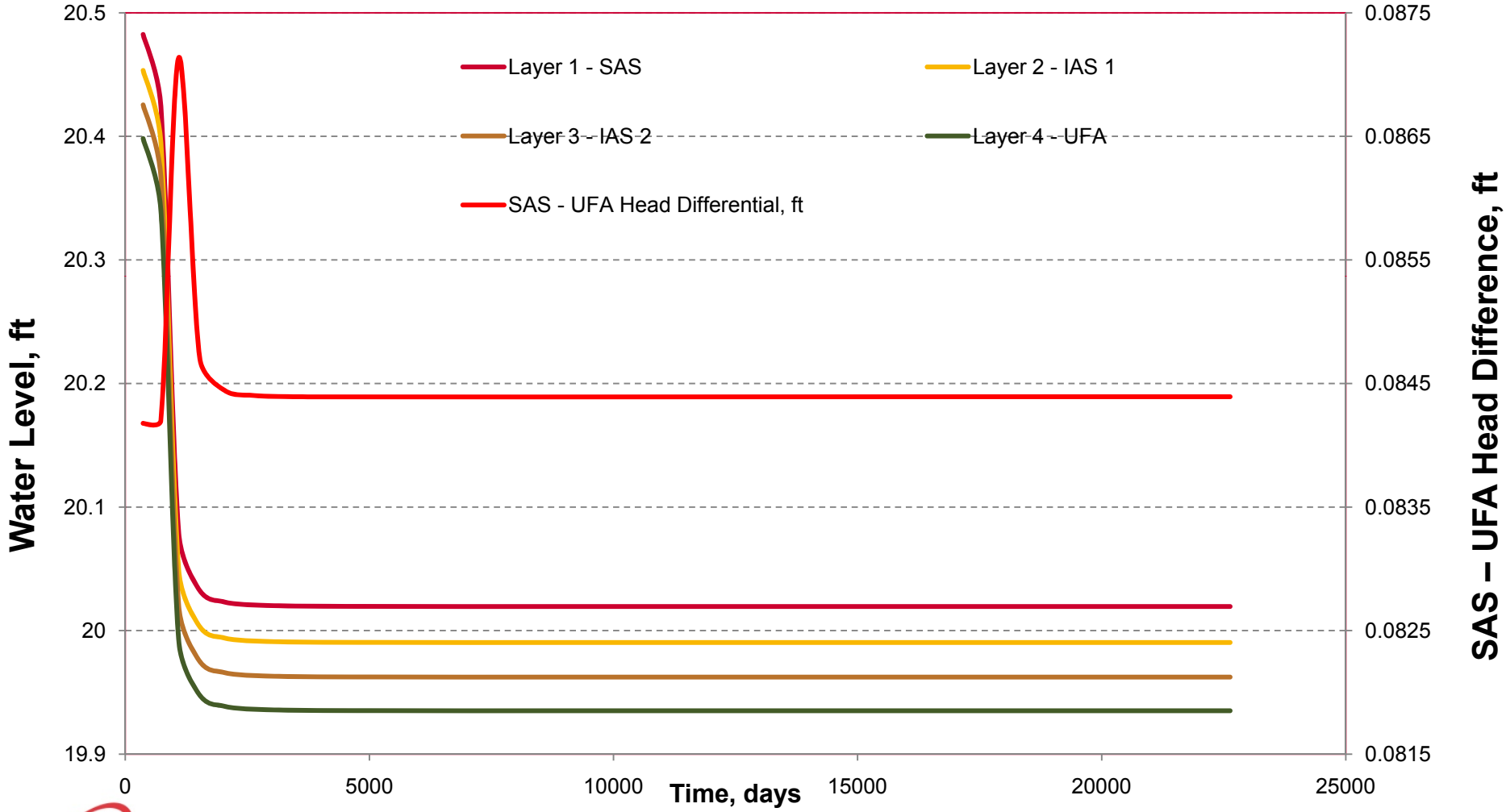
Model Water Budgets

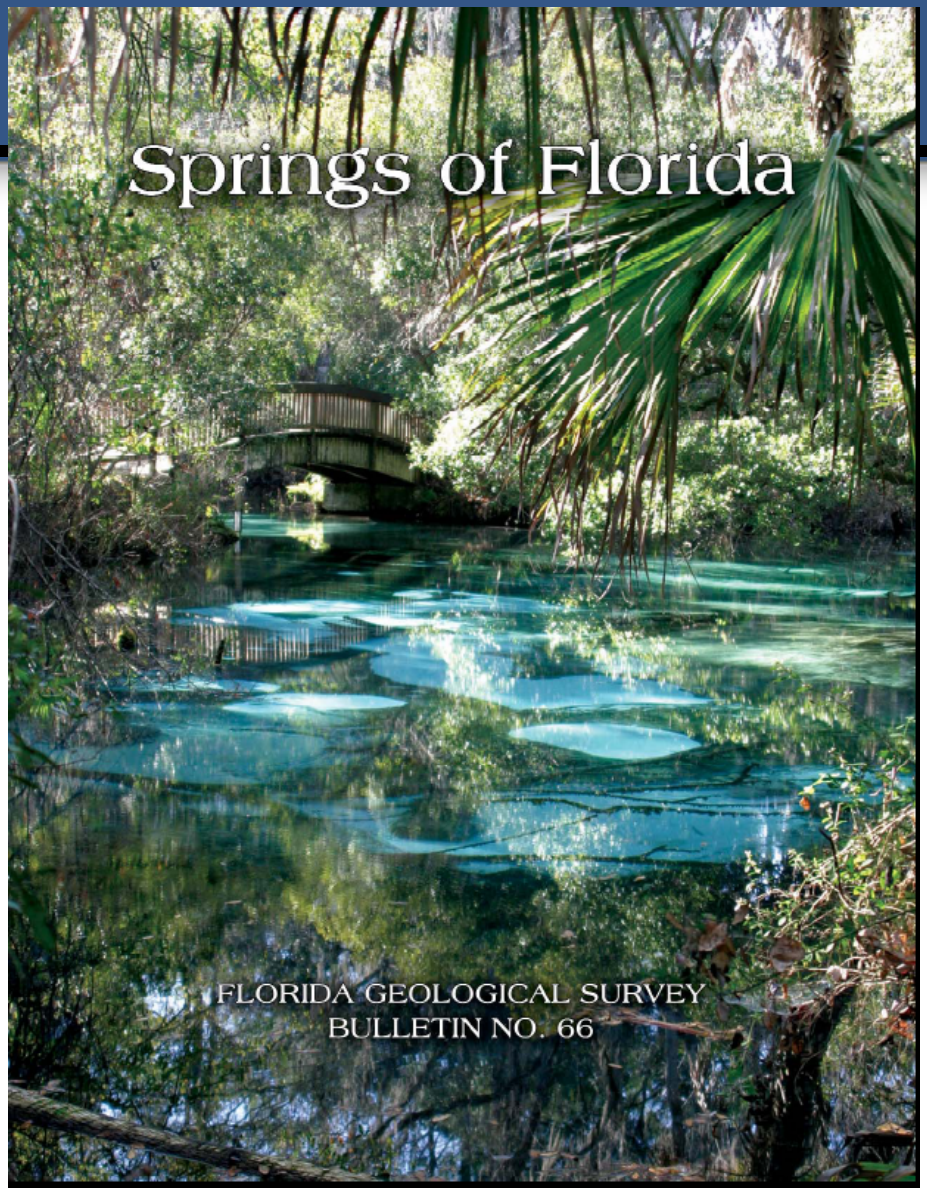
- In the 3-layer model…
  - There is minimal exchange of water between the river and the aquifer
  - Net flows from river to aquifer are 1.5 times the flow from the aquifer to the river
- In the 5-layer model…
  - Nearly 10x more flow between river and aquifer than the 3-layer model
  - The aquifer flows to the river are approximately twice the river losses to the aquifer

SAS Response to UFA Withdrawals

- The SAS responds simultaneously to the UFA in the 5-layer model
- The presence of Layers 2 and 3 does not buffer or minimize the drawdown
- Head difference between SAS and UFA does not increase significantly with withdrawals, indicating excellent communication between the two aquifers

SAS and UFA Substantially Equilibrated in Less Than 2 Years





BULLETIN NO. 66

SPRINGS OF FLORIDA

by

Thomas M. Scott (PG #99), Guy H. Means,
Rebecca P. Meegan, Ryan C. Means,
Sam B. Upchurch, R. E. Copeland,
James Jones, Tina Roberts, Alan Willet

BULLETIN 66

LEVY COUNTY

Big King Spring

Location – Lat. 29? 06' 59.12" N., Long. 82? 38' 32.14" W. (SW¼ NW¼ SE¼ sec. 1, T. 16 S., R. 16 E.). Big King Spring is located on private land 5.5 miles (8.9 km) north of Inglis. It is adjacent to and on the northwest side of the Caruth Sherriff's Youth Camp property and is not publicly accessible.

Description – Big King Spring pool measures 75 ft (22.9 m) north to south and 45 ft (13.7 m) east to west with an estimated depth of 8 ft (2.4 m). Three small boils with 5 -8 ft (1.5 m – 2.4 m) long rivulets emerge from limestone cracks at the base of a sand hill on the east side of the spring pool. Another small vent with a visible boil issues from the pool center. The spring pool was tannic during the August 2003 visit though water flowing from the spring vents was clear. This wild spring sits in a dense hardwood lowland forest with sand hills rising to 8 ft (2.4 m) on the east side of the spring pool. Flow from Big King and Little King Springs flow through the Gulf Hammock region of the Big Bend into the Gulf of Mexico, in or near Withlacoochee Bay. Other names for this spring are Big Spring or King Spring. This spring is surrounded by private property.

Little King Spring

Figure 162. Little King Spring (photo by Springs Fever).

Location – Lat. 29° 06' 39.05" N., Long. 82° 38' 52.14" W. (NW¼ NE¼ NW¼ sec. 12, T. 16 S., R. 16 E.). Little King Spring is located within a dense hardwood swamp on the western side of Caruth Camp, a Sherriff's Youth Ranch. The property is on the west side of US 19/98 approximately 5 miles (8.1 km) north of Inglis. Permission to visit this spring must be obtained from the camp office.

Description – Little King Spring sits in a low banked bowl-shaped depression surrounded by a wooden boardwalk. The spring pool is approximately 35 ft (10.7 m) in diameter. There are two vents, one east and one on the west side of the pool with estimated depths of 15 to 20 ft (4.6 to 6.1 m). Limestone is present near each of the vents. The spring was tannic during the August 2003 visit but is reported to flow clear during drier times. The run averages 2 ft (0.6 m) deep and 10 ft (3.1 m) wide and flows west through the swamp, eventually reaching the Gulf of Mexico in or near Withlacoochee Bay. Wooden bleachers are built on the east side of the spring for presentations. This spring is also known as Caruth Spring or Little Spring. The spring is surrounded by the Florida Sheriff's Youth Ranch.